Low Mass Electromagnetic Plasmoid Thruster with Integrated PPU

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National Aeronautics and Space Administration

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Small Business Information
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Abstract
The Electromagnetic Plasmoid Thruster (EMPT) is a revolutionary electric propulsion thruster and power processing (PPU) system that will allow a dramatic decrease in system mass and increase in thrust efficiency over traditional 500-1000 W propulsion systems. The high specific power (>700 W/kg) and high efficiency of EMPT will enable a wide range of deep space missions such as Neptune, Pluto and Oort Cloud orbital insertion. Additionally, a solar electric EMPT system would dramatically increase the capability and reduce the travel time of an asteroid or Martian moon sample and return mission due to the variable-power, low-mass propulsion system. The EMPT employs a Rotating Magnetic Field (RMF) to produce large plasma currents inside a conical thruster creating a plasmoid that is magnetically isolated from the thruster walls. The intensified gradient magnetic field from the plasmoid together with the large plasma currents result in an enormous body force that expels the plasmoid at high velocity. The EMPT is a pulsed device, nominally operating at 1 kWe with 1 Joule discharges at 1 kHz. Presented is a full description of the relevant plasma physics as well as the thruster and PPU design. All physical principals behind the EMPT have been demonstrated in the laboratory at the relevant scales. Additionally, the AFOSR-funded ELF thruster has demonstrated RMF formation and acceleration in a thruster application at higher energy levels. The focus of the proposal is the experimental validation of an integrated thruster and PPU operating in a multi-pulse mode. The EMPT will be characterized over a range of parameters: input power from 200-1000 Watts, 50-80 mN thrust, and 1500-4000 seconds specific impulse. The integrated thruster and PPU to be built and tested will have a total system mass of less than 1.5 kg. Successful completion of Phase I will mature the technology from a TRL level 3 to 5. Phase II will be a fully integrated, steady-state demonstration with life test.

* information listed above is at the time of submission.